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## Blanford's fox in Africa

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**Abstract.** A specimen of *Vulpes cana* Blanford, 1877 from the western Red Sea shore in Egypt is reported, expanding the species' known distributional range from the wider Plateau of Iran, the margin of the Arabian Peninsula, Israel, and the Sinai into the African continent. Problems concerning the species' distribution and identification are discussed.

**Key words.** Mammalia, Carnivora, Canidae, Blanford's fox, *Vulpes cana*, Africa, Egypt.

### Introduction

Since its original description from Baluchistan, SW Pakistan, Blanford's fox (*Vulpes cana* Blanford, 1877) remained a little known species (Clutton-Brock et al. 1976, Ginsberg & Macdonald 1990, Sheldon 1992) with only few additional specimens reported from W Pakistan (Pocock 1941, Roberts 1977), E Afghanistan (Pocock 1941, Hassinger 1973, Nauroz 1974), S Turkmeniya, S Tadzhikistan (Shitkov 1907, Bobrinskii et al. 1944, Novikov 1962, Ognev 1962, Heptner & Naumov 1974, Potansky 1993), and the Iranian provinces of Khorassan, Fars, and Khuzistan (Birula 1912, Lay 1967) (for a detailed listing of most documented localities see Geffen et al. 1993), until in 1981 it was discovered to occur in E Israel (Ilany 1983). Eventually, further records of this fox from more localities in E and S Israel and the southern Sinai (Mendelsohn et al. 1987, Geffen et al. 1993), Oman (Harrison & Bates 1989, Kingdon 1990) and Saudi Arabia (Al-Khalili 1993, Geffen et al. 1993) were published. Probably because there are so few documented distributional records of *V. cana* and the localities are so widely scattered geographically, most authors who recently published on the distribution of this species (Mendelsohn et al. 1987, Harrison & Bates 1989, Kingdon 1990, Geffen et al. 1993) hypothesized about the actual extent of its distributional range. Not listing the Arabian Peninsula, Israel, and the Sinai, the species' distribution given in the very recent checklist of the mammal species of the world (Wozencraft 1993) is incomplete.

Shortly following its discovery in Israel, Blanford's fox was the subject of intensive research there through which the hitherto poor knowledge of its biology increased considerably (Dayan et al. 1989, Geffen & Macdonald 1992, 1993, Geffen et al. 1992a, b).

### Results

Here we report on a fox collected by R. Rödel on a talus slope in Wadi Qiseib (29° 24' N 32° 29' E), Governate Suez, Egypt, (see Fig. 1, 2) on January 23, 1988, about 7.5 km off the coastal road. The general locality (Bir Qiseib in Wadi Qiseib) is figured photographically in Osborn & Helmy (1980: 31, Fig. 16). The individual, a young adult ♂ of an estimated age between one and two years (testes fully descended, diameter 21 mm) was trapped on a slope (about 150 m a. s. l.) a short distance

beyond the site shown on the middle right margin of this photo, about 200 m linear distance from the bottom of Bir Qiseib. For two days prior to its collection date it had been observed in that area, actively searching for prey around and under boulders until about one hour after dawn. Osborn & Helmy (1980) listed *Vulpes vulpes aegyptiaca* and *Vulpes r. rueppelli* from the same locality where this specimen of Blanford's fox was collected.

The animal was prepared by J. Handwerk and the skull later given to J. Niethammer, Bonn. All persons involved took it for a specimen of *Vulpes rueppelli*. Only in 1993 when it was incorporated into the collections of the Museum Koenig, Bonn (ZFMK 93.354), the correct identification as *V. cana* was made. Its small dimensions (see Table 1 for its measurements; for a comparison with those of *V. rueppelli* see Osborn & Helmy [1980], Gasperetti et al. [1985], and Mendelsohn et al. [1987]) and especially its slender rostrum are characteristic (Harrison & Bates 1989). The skull is in good condition, the teeth showing very little wear, the sutures between all cranial bones being clearly discernible. The study skin confirms the corrected species identification with the presence of the diagnostic criteria of a black tail tip and especially the relatively short hair on the palmar and plantar surfaces with fully visible footpads (see Fig. 3). The fur is thick and soft, the tail is bushy. The black lacrimal stripe is well developed, extending relatively far rostrad over the muzzle to the lower jaw and covering nearly the whole chin. The back of the ears is grey. The general coat colour is beige; head, nape, shoulders, and the forelegs have a conspicuous rufous tinge, less pronounced on the chest, lower abdomen and inner thighs of the hindlegs. A relatively broad spinal stripe, fading caudad from the sacral region, also has a rufous tinge. The basal portion of the thick under hair is grey all over the body. The claws are relatively short and blunt.

## Discussion

### The distribution of Blanford's fox

The present record of *Vulpes cana* is the first of this species from the African continent (the Suez Canal usually being considered the dividing line between Africa and Asia) and promptly confirms Geffen's et al. (1993) hypothesis that it is likely to occur on the western shore of the Red Sea. However, whether and how far Blanford's fox actually ranges further southward along the western shore of the Red Sea and westward into the Egyptian, Nubian and Libyan Deserts has yet to be established. Suitable (mountainous) rocky habitat stretches all along its western shore from Egypt southward through Sudan well into Ethiopia and far westward, only interrupted by the valley of the Nile River. Careful reexamination of possibly misidentified specimens of *Vulpes rueppelli* from NE Africa in existing collections and further trapping/collecting are necessary to determine the actual extent of the species' African distributional range. Only then it would be possible to determine whether the specimen of *V. cana* reported here documents this species' fairly recent range extension into the African continent or it only was a stray individual from the Sinai, or whether it is the first material indication of its (much wider?) autochthonous occurrence in NE Africa. We hold that most likely the last hypothesis is correct.

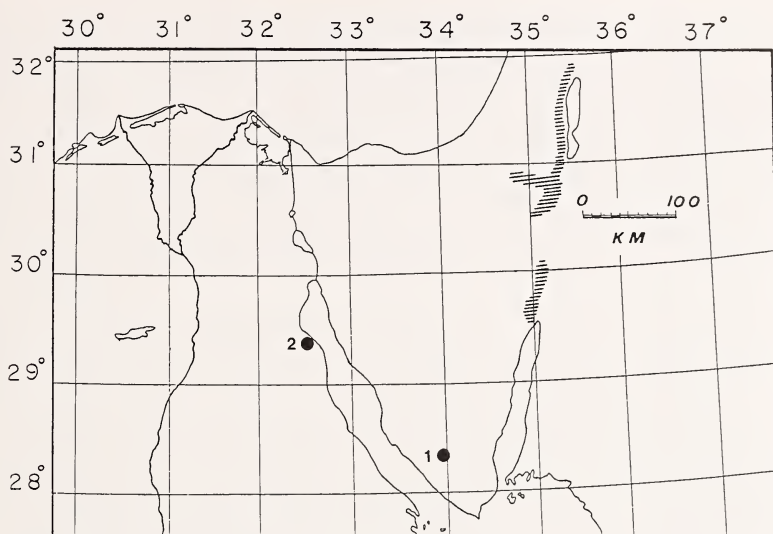


Fig. 1: Distribution of *Vulpes cana* in Israel (hatched) and southern Sinai (1) (see Geffen et al. [1993] for details); 2: the new record from Egypt on the western Red Sea shore.

The collections of the Museum Koenig contain a flat tanned skin of *Vulpes cana* (ZFMK 93.376), purchased in the furriers' market of Herat, NW Afghanistan, in winter 1972 by M. K. Nauroz. The animal had allegedly been taken in the vicinity of Chaghcharan, central Afghanistan ( $34^{\circ} 31' \text{ N } 65^{\circ} 15' \text{ E}$ ) (about 2300 m a. s. l.). If this is correct, this locality would bridge the gap between the hitherto published records from SW Pakistan and SE Afghanistan on the one hand and those from NE Iran and S Turkmeniya on the other. It would also raise doubts whether the species is only found at altitudes below 2000 m as maintained by Hassinger (1973). Niethammer (1983) stated that there are few distributional records of *Vulpes cana* from N and S Afghanistan but the only one hitherto published from that country is a skin obtained in Kandahar (Pocock 1941), the exact geographical origin of which is not even clear (Hassinger 1973). So the specimen reported here is only the second record of Blanford's fox from Afghanistan.

Those distributional records hitherto known of the species which seem to be properly documented are summarized in Fig. 2. For some of these records it is not clear, however, from the data published in the literature what kind of material they were based on and whether it was preserved (see Table 2). Non-verifiable ones like (possible) sightings in Iran (Lay 1967) or India (Ranjitsinh 1985) or a controversial photographic record (Gasperetti et al. 1985, Harrison & Bates 1989) from Saudi Arabia are not entered on this map. Basically the distribution area of *Vulpes cana* divides into two parts: the wider Iranian Plateau on the one hand and the Arabian Peninsula/Near East on the other, the latter expanded now to NE Africa by the specimen from Egypt reported here. With the exception of the relatively numerous records from Israel (and those from Egypt) the few remaining ones are widely scat-

Table 1: Weight [g], body and skull measurements [mm] of *Vulpes cana*. (W — weight; HB — head and body; T — tail; E — ear; F — hindfoot; CBL — condylobasal length; ZB — zygomatic breadth; BB — breadth of braincase; IC — interorbital constriction; CM<sup>2</sup> — maxillary teeth; CM<sub>3</sub> — mandibular cheekteeth). (BM — British Museum [Natural History], London; ONHM — Oman Natural History Museum, Muscat; ZFMK — Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn; ZMTAU — Zoological Museum Tel Aviv University, Tel Aviv).

| specimen            | locality            | sex | W     | HB  | T   | E  | F   | CBL  | ZB   | BB   | IC   | CM <sup>2</sup> | CM <sub>3</sub> | rostral width above P <sup>1</sup> | source |
|---------------------|---------------------|-----|-------|-----|-----|----|-----|------|------|------|------|-----------------|-----------------|------------------------------------|--------|
| Israel              |                     |     |       |     |     |    |     |      |      |      |      |                 |                 |                                    |        |
| ZMTAU 7750          | Machresh Ramon      | ♂   | 956   | 438 | 324 | 81 | 92  | 82.7 | 51.0 | 36.9 | 17.8 | 41.3            | 45.7            | —                                  | 1      |
| ZMTAU 7704          | En Gedi             | ♀   | —     | —   | —   | —  | —   | 83.5 | 47.8 | 35.1 | 16.8 | 42.0            | 44.5            | —                                  | 1      |
| ZMTAU 7952          | En Gedi             | ♀   | 955   | 416 | 328 | 83 | 93  | 85.5 | 50.0 | 36.3 | 17.1 | 40.1            | 43.2            | —                                  | 1      |
| ZMTAU 7954          | En Gedi             | ♀   | —     | —   | —   | —  | —   | 85.2 | 50.2 | 35.1 | 16.3 | 40.4            | 45.8            | —                                  | 1      |
| ZMTAU 7874          | CCZE                | ♀   | 710   | 406 | 324 | 88 | 101 | 83.0 | 42.4 | 35.5 | 15.3 | 38.2            | 44.0            | —                                  | 1      |
| Egypt               |                     |     |       |     |     |    |     |      |      |      |      |                 |                 |                                    |        |
| ZMTAU 7195          | Southern Sinai      | —   | —     | —   | —   | —  | —   | 85.9 | 49.0 | 36.3 | 17.1 | 38.7            | 43.3            | —                                  | 1      |
| ZFMK 93.354         | Wadi Qiseib         | ♂   | 1 050 | 391 | 281 | 80 | 91  | 90.1 | 48.1 | 35.4 | 16.5 | 40.3            | 45.1            | 12.2                               | 2      |
| Oman                |                     |     |       |     |     |    |     |      |      |      |      |                 |                 |                                    |        |
| ONHM 952            | Dhofar              | ♀   | —     | 385 | 350 | 76 | 97  | 93.5 | 51.0 | 34.3 | 17.1 | 42.8            | 46.9            | 13.2                               | 3      |
| ONHM 1000           | Dhofar              | ♂   | —     | 400 | 360 | 80 | 101 | 96.4 | 51.9 | 36.8 | 17.5 | 44.7            | 47.7            | 14.0                               | 3      |
| Pakistan            |                     |     |       |     |     |    |     |      |      |      |      |                 |                 |                                    |        |
| BM 1919.11.7.22     | Turbat, Baluchistan | ♂   | —     | 406 | —   | 89 | 102 | 91.3 | —    | 35.1 | 17.4 | 43.8            | 48.3            | 13.5                               | 3      |
| BM 1878.4.23.1*     | Gwadar, Baluchistan | —   | —     | —   | —   | —  | —   | 89.0 | 50.5 | —    | 19.0 | 41.5            | —               | —                                  | 4      |
| Kharan, Baluchistan |                     |     |       |     |     |    |     |      |      |      |      |                 |                 |                                    |        |
|                     |                     | —   | —     | 422 | 298 | 74 | 78  | —    | —    | —    | —    | —               | —               | —                                  | 5      |

Sources: 1 — Mendelsohn et al. (1987); 2 — this study; 3 — Harrison & Bates (1989); 4 — Pocock (1941); 5 — Roberts (1977); \* — type specimen



tered within each of the two parts of the distribution area. At the present state of knowledge it is not possible to decide whether this reflects the species' actual rarity throughout most of its distributional range or is just paucity of records in scientific collections, partly due to the secrecy and nocturnal habits of this fox. Lay (1967: 206) mentioned that in Iran skins of Blanford's fox "were rather common at fur shops, particularly at Tehran", and the intensive search for *Vulpes cana* in Israel during the last decade revealed that it is common there in mountainous desert ranges (Mendelsohn et al. 1987, Geffen et al. 1993). Therefore it is again all the more astonishing that the species is not mentioned in a recent survey of carnivores in Jordan (Qumsiyeh et al. 1993).

Generally there is uncertainty about the exact geographical origin of those specimens (skins) of Blanford's fox from Pakistan, Afghanistan, and Iran which were obtained in fur bazaars or otherwise indirectly (these records are specifically identified in Fig. 2). Al-Khalili (1993), and Geffen et al. (1993) listed a skin from Bajaur (= Bezaur?), North Waziristan, Pakistan, which very likely is the same specimen (BM 1907.6.8.1) mentioned by Pocock (1941) as purchased in a shop in Peshawar and said to be from Bezaur, North West Frontier Province, Pakistan. The qualification of locality data in such specimens ought to be heeded. Some confusion also exists in the literature as to the precise geographical location of a particular record of this fox species from the former USSR. The locality Bokhara (= Bukhara), Uzbekistan, as listed by Lay (1967), Al-Khalili (1993), and Geffen et al. (1993) (with coordinates), resp. Bokhara Mts, Uzbekistan (Corbet 1978), is a misunderstanding. Other names published like Bokhara in Turkestan (Pocock 1941), Bukhara Mountains (Ognev 1962), or Bokhara, Russian Turkestan (Ellerman & Morrison-Scott 1966) are also not precise enough to preclude misconception without consulting the original publication of this record (Shitkow 1907) in which *Vulpes cana* var. *nigricans* was named. The record is based on one mounted specimen and three skins. According to information provided by the collector(?) / donor Th. K. Lorenz, all four specimens had been obtained in the same area (fide Shitkow 1907). In that publication it was variably and rather vaguely named as "the mountainous part of Bukhara", "mountainous Turkestan", and "near the borders of Bukhara" (translation of the original German text, G. P.). It was later restricted by Heptner (Heptner & Naumov 1967: 269) to S Tadzhikistan ("mountainous Bukhara"). Although with a question-mark in parentheses, Pavlinov & Rossolimo (1987: 53) further restricted it to the districts of Kurgan-Tyube and Kulyab, Tadzhikistan. At the time of the publication of this record, Tadzhikistan was a part of the former Bukhara Emirate, a Russian protectorate then. So the locality in question definitely is neither the city of Bukhara in Uzbekistan, the capital of the former Bukhara Emirate, nor Bokhara Mts, Uzbekistan. Bobrinskii et al. (1944) and Heptner & Naumov (1974) entered the S Tadzhikistan locality into their distribution maps for Blanford's fox. Ognev (1962) argued that it is quite likely to occur there but other authors like Heptner & Naumov (1974) or Potansky (1993) seriously doubted it, and Novikov (1962) did not even list this locality. The only records of *Vulpes cana* from the former USSR that these latter authors accepted as reliable are those from S Turkmeniya.

As mentioned earlier, authors like Mendelsohn et al. (1987) or Geffen et al. (1993) put forward hypotheses about the actual extent of the distributional range of Blan-

Table 2: Records of *Vulpes cana* entered in Fig. 2.

| rec. no.     | country/locality                  | nature of specimens (s)     | source | comments                                                |
|--------------|-----------------------------------|-----------------------------|--------|---------------------------------------------------------|
| Pakistan     |                                   |                             |        |                                                         |
| 1            | Gwadar, Baluchistan               | skin + skull                | a      | type                                                    |
| 2            | Turbat, Baluchistan               | skin + skull                | b      |                                                         |
| 3            | Kharan, Baluchistan               | skin?                       | c      | nature of specimens not clear;                          |
| 4            | Chagai, Baluchistan               | skin?                       | c      | records not preserved?                                  |
| 5            | Khuzdar, Baluchistan              | skin                        | d      |                                                         |
| 6            | Bajaur, North Waziristan          | skin                        | b, c   |                                                         |
| Afghanistan  |                                   |                             |        |                                                         |
| 7            | Kandahar                          | skin                        | b      |                                                         |
| 8            | Chagcharan                        | skin                        | e      |                                                         |
| former USSR  |                                   |                             |        |                                                         |
| 9            | S Tadjikistan                     | 3 skins, 1 mounted specimen | f      |                                                         |
| 10           | Saramsaky, Turkmeniya             | skin                        | g      |                                                         |
| 11           | Bakharden, Turkmeniya             | skull fragment              | h      | perhaps additional material                             |
| Iran         |                                   |                             |        |                                                         |
| 12           | Duruch, Khorassan                 | skin                        | i      |                                                         |
| 13           | Shiraz, Fars                      | 3 skins                     | j      |                                                         |
| 14           | Ahmad Mahmoudi, Fars              | remains                     | j      | record not preserved?                                   |
| 15           | Faridan, Khuzistan                | 2 skins                     | j      |                                                         |
| Oman         |                                   |                             |        |                                                         |
| 16           | Jabal Samhan, Dhofar              | 2 skulls, 1 skin, 1 baculum | k      |                                                         |
| Saudi Arabia |                                   |                             |        |                                                         |
| 17           | 40 km SE Biljurshi, Asir Province | remains                     | l, m   | record not preserved?                                   |
| Israel       |                                   |                             |        |                                                         |
| 18           | various numerous records          | various                     | m, n   | localities see source m; records not for all localities |
| Egypt        |                                   |                             |        |                                                         |
| 19           | Jabel Umm-Shawmar, Sinai          | skull?                      | m, n   | nature of specimen not clear                            |
| 20           | Wadi Qiseib                       | skin + skull                | e      |                                                         |

Sources: a — Blanford (1877); b — Pocock (1941); c — Roberts (1977); d — P. Jenkins (in litt. 1993); e — this study; f — Shitkow (1907); g — Ognev (1962); h — Novikov (1962); i — Birula (1912); j — Lay (1967); k — Harrison & Bates (1989); l — Al-Khalili (1993); m — Geffen et al. (1993); n — Mendelsohn et al. (1987)

ford's fox, the latter authors (l. c.: 106, Fig. 1) even marking a "predicted range in the Middle East" in the distribution map presented and arguing that "It is possible that in the future this fox will be found in north-west India and along the western Red Sea shore south to Ethiopia." If *Vulpes cana* originated in the Plateau of Iran from where it extended its range to the Near East, following the marginal mountain ridges in the south and west of the Arabian Peninsula and if it is strictly bound to (mountainous) rocky desert habitat as maintained by Geffen et al. (1993), Mesopotamia and the open flat and sandy deserts of Iraq, Syria, Jordan and the north-eastern and central part of the Arabian Peninsula formed a natural barrier against the westward expansion of its distributional range beyond the wider Plateau

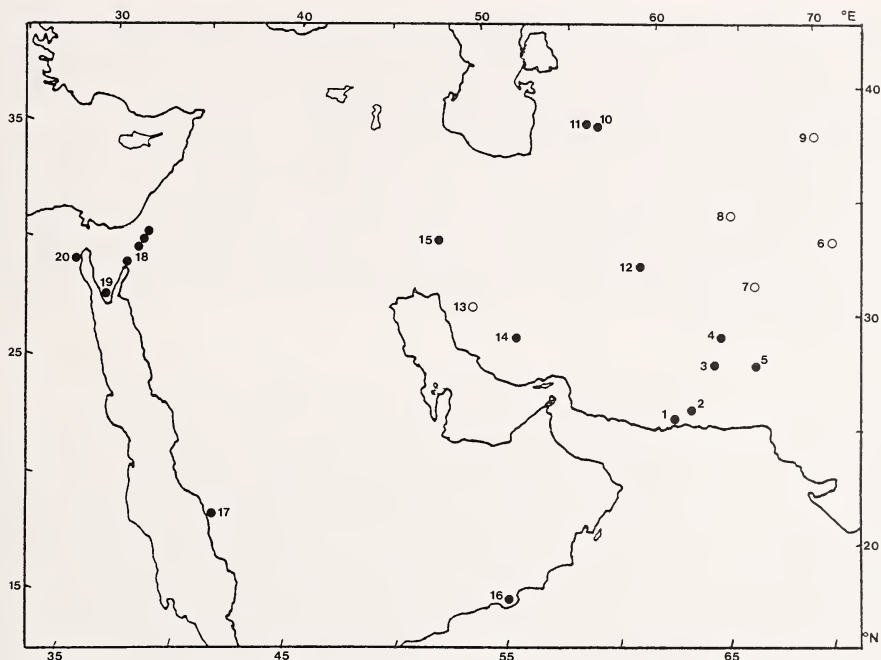


Fig. 2: Distribution of *Vulpes cana* based on properly documented records (for details see Table 2). ●: geographical provenance of record(s) entered definite; ○: geographical provenance of record(s) entered unknown resp. questionable. For details of distribution in Israel see Geffen et al. (1993) resp. Fig. 1.

of Iran. Only if the Street of Hormuz had fallen dry during the last glacial period(s) the species could have crossed it and extended its range into the Arabian Peninsula and from there further on in the way hypothesized by Geffen et al. (1993). Certainly suitable (mountainous) rocky desert habitat extends beyond the margin of the documented distributional range of *Vulpes cana*, especially from NW Iran westward to N Iraq and E Turkey and beyond the presently known extreme eastern and north-eastern records in Afghanistan, the former USSR and Pakistan, but no statement is possible as to the species' presence in these areas resp. its absence from these.

To the best of our knowledge there is no other mammal species with a distribution pattern largely matching the one presently known of Blanford's fox. The eastern part of the distributional range of the sand cat *Felis margarita* from the Sinai in the W to Uzbekistan and Pakistan in the E matches that of Blanford's fox to some extent. However, *Felis margarita* differs from *Vulpes cana* being adapted chiefly to sandy desert habitat (Harrison & Bates 1991) and is present in the whole of the N African desert belt from Morocco to Egypt (Hemmer et al. 1976) from where records of Blanford's fox are lacking until now. The combined distributional ranges of the two hedgehog species *Paraechinus aethiopicus* and *Paraechinus hypomelas* largely coincide with the range of the sand cat (Corbet 1988). The eastern species *Paraechinus*



*hypomelas* lives on gravelly slopes or rocky areas in desert and arid steppe zones of Iran, Afghanistan, Pakistan, Uzbekistan and Turkmeniya, with isolates in Oman, near Aden and on two islands in the Persian Gulf (Roberts 1977, Corbet 1988), so roughly comparable to *Vulpes cana* in respect of habitat and geographical range. Yet, at the present state of knowledge there seems to be only limited sense in comparing the very likely incompletely known distributional range of Blanford's fox with completely resp. likewise incompletely documented ranges of other mammal species, in order to arrive at a hypothesis on the eventual ultimate causation of the specific distributional pattern of this fox species. Mendelsohn et al. (1987) already noted that the distribution of Hume's tawny owl (*Strix butleri*) to a certain extent is similar to that of *Vulpes cana*.

#### Geographical variability of Blanford's fox

The colour and markings of the ZFMK skin of Blanford's fox from Afghanistan almost fully correspond with Clutton-Brock's et al. (1976) description of skins of *Vulpes cana* in the collections of the British Museum (Natural History), including the type, and all from the wider Iranian Plateau: ". . . blotchy black, grey and white with a dark tip to the tail and a dark patch over the tail gland. There is an almost black mid-dorsal line . . . The underparts are almost white; the ears are grey, and there is a small dark patch between the eyes and nose", and the total lack of any rufescent tinge. The back, neck, and especially the forehead show a very faint ochreous wash. The feet are uniformly grey with a fringe of white hairs around the toes. The footpads are naked, the claws are relatively short and blunt. This skin differs considerably from the coloured figure of *V. cana* from Pakistan in Mivart (1890: Plate XXXI), based on the type specimens, which has a rufous wash, especially on the head and back, only a faint lacrimal stripe, and dark transverse bands on the dorsal side of the tail. Pocock (1941) described differences in intensity and extension of their ochreous wash in the four coats of Blanford's fox from Pakistan and Afghanistan, then held in the collections of the British Museum (Natural History).

As far as can be judged by photos of Blanford's fox from Israel published in Gefen & Hefner (1992) and Macdonald (1992), the ZFMK specimen from Egypt largely matches these in coat colour and markings. From these the ZFMK skin from Afghanistan clearly differs in a generally greyish colour, the absence of any rufous tinge and the presence of a black dorsal stripe. However, Harrison & Bates (1989: 75) noted that in the sample of *Vulpes cana* skins they studied ". . . the blackish mid-dorsal spinal crest which is a marked feature of the specimen from Israel is less evident in the example from Dhofar . . .". So, there seems to be considerable individual variation in this character, as already supposed by these authors. Despite the difference in general colour, both coats have thick grey under hair, in both the back of the ears is grey and the black lacrimal stripe is distinct, extending over the muzzle to the chin which is nearly black. This stripe is also clearly visible in the photo of a mounted specimen of *Vulpes cana* from Tadzhikistan figured in Shitkov (1907), and this individual also has a black chin. Shitkov (1907) also noted that two of the three skins from Tadzhikistan studied by him had a rufous tinge on the shoulders. Nevertheless, it seems that the general coat colour of Blanford's fox is grey in the



population of the wider Plateau of Iran and beige with a rufous tinge of variable extent and intensity in that on the Arabian Peninsula, in Israel and Egypt. Individual variation in coat colour and markings does occur and seasonal variation in these characters and coat quality is very likely to occur but considerably more and better documented specimens are needed to evaluate and understand this variability over the species' whole distributional range.

Because of the small data base a comparison of measurements of individuals of this fox from different parts of the species' distributional range (see Table 1) can only be made with considerable reservations. Compared with the specimens from all other localities, the one from Egypt is smaller in most external measurements and especially has a proportionally shorter tail. Body weight was recorded in too few specimens of *Vulpes cana* to draw definite conclusions from the differences in this respect between the specimen from Egypt and those from Israel. Cranial measurements show no unequivocal developmental trend, with the exception of condylobasal length (CBL). CBL generally is smallest in the specimens from Israel, intermediate in the one from Egypt and those from Pakistan and largest in those from Oman. However, the sample size of skulls of Blanford's fox from all parts of its distributional range with the exception of Israel is much too small to evaluate and understand the variability of cranial measurements in this species. Therefore the significance of differences in these characters between the populations of *V. cana* as listed in Table 1 (which represents the complete published sample of skulls of this species) cannot be assessed. Harrison & Bates (1989: 76) argued that the size differences between the specimens from Israel and those from Oman "... certainly suggest that the Dhofar population may be subspecifically different." We hold, however, that the number of specimens of Blanford's fox for which the relevant measurements are available at present is not large enough to substantiate this hypothesis. The only adequately documented difference in the known sample is that in general coat colour between animals from the wider Iranian Plateau and those from the Arabian Peninsula/Near East portion of the species' distributional range. Whether this difference (or others among these or other populations) justifies the attribution of subspecific status to these two populations (or others) can only be decided when the species' total distributional range and the geographical distribution of character variability are sufficiently known.

### Problems of species determination

In studying character displacement in cranial characters of the three Saharo-Arabian fox species *Vulpes vulpes*, *V. rueppelli*, *V. cana*, Dayan et al. (1989) evaluated condylo-basal length, antero-posterior diameter of the upper canines and lower carnassial length. The populations of *V. rueppelli* and *V. cana* from Israel showed no overlap in condylo-basal length, a partial overlap in lower carnassial length and a complete overlap in the upper canine measurements, whereas those of *V. cana* from Israel and *V. rueppelli* from the Sinai overlapped completely in all three measurements. There was no or only marginal overlap in these three cranial measurements for Blanford's fox with the other *V. rueppelli* populations studied (from Arabia, Egypt, Algeria). Sample size for *V. cana* from Israel was very small ( $n = 3$ ), though,

and in *V. rueppelli* may also not have been sufficient ( $n = 4-9$ ) to be fully representative of the respective populations. These data and those published by Osborn & Helmy (1980), Gasperetti et al. (1985), Mendelsohn et al. (1987), and Harrison & Bates (1991) document that (certain) cranial measurements of *V. rueppelli* vary considerably over parts or perhaps the whole of its distributional range and that for some populations they (partly) overlap with those of *V. cana*. As stated above, the actual range of variability in these measurements in Blanford's fox is not established yet. It is very likely that occasionally this situation led to incorrect identifications of museum specimens of the latter species as *V. rueppelli* if the decision was or had to



Fig. 3: Right forefoot of an ad. ♂ *Vulpes cana* (study skin ZFMK 93.354) (right) and (left) forefoot of an ad. ♀ *Vulpes rueppelli* (study skin ZFMK 89.101), both from Egypt. The diagnostic difference between the two species in the length of the palmar (and plantar) hair is marked. In *V. rueppelli* this hair is long, forming a cushion as an enlarged tread which conceals the footpads. In *V. cana* this hair is much shorter and does not form such a cushion, so the footpads are visible.

be solely or mainly based on cranial material. The reverse is much less probable because only so few skulls identified as *Vulpes cana* are known.

However, the situation seems to be more complex. E. g., all available skull measurements of a young adult ♂ specimen identified as *V. rueppelli* in the collection of the Field Museum of Natural History, Chicago (FMNH 89592), are within the range for *V. cana* (Table 1). Most are (considerably) smaller than the corresponding measurements published of *V. rueppelli* specimens from Egypt (Osborn & Helmy 1980) or the Arabian Peninsula (Gasperetti et al. 1985, Harrison & Bates 1991); in a few measurements there is marginal overlap. Therefore, based on cranial measurements, this specimen (FMNH 89592), collected in Wadi el Sheik, St Catharine's Monastery Area, South Sinai, Egypt, on May 22, 1958 by H. Hoogstraal, would more likely be identified as *Vulpes cana* than as *V. rueppelli*. At the present state of knowledge the most reliable diagnostic character to distinguish between these two fox species seems to be an external one: in *V. rueppelli* palmar and plantar surface are covered by long hair forming a kind of cushion as an enlarged tread surface, largely concealing the footpads of fore and hind feet, whereas in *V. cana* the tread surface of fore and hind feet is not enlarged by long hair and therefore the pads are (almost) fully visible (see Fig. 3). Sometimes this diagnostic difference may be less pronounced than in the specimens figured, especially so in flat skins with palmar and plantar skin surface cut open. Then the sole pads in *V. rueppelli* skins can be a bit more exposed. However, the diagnostic difference is not due to the preparation procedure. This is obvious in comparing photos of the feet of live specimens of both species: *V. rueppelli* (see Gasperetti et al. 1985: 408, especially left hind foot of figured individual); *V. cana* (see Geffen & Hefner 1992: 19, especially right fore foot of that animal). Only the former animal figured has dense and long hair on the soles forming an enlarged hairy cushion. The feet on the skin of the fox specimen FMNH 89592 show the long hair typical of *V. rueppelli*, confirming the original species identification, despite of the fact that most of its cranial measurements would rather suggest its identification as *Vulpes cana*.

We hold that because of the situation detailed before only a careful study of skull morphology and teeth, size variation and sexual dimorphism as well as other character complexes in either of these *Vulpes* species, based on a sufficient sample from their entire distributional range, can help to settle the extant problems in species delimitation/identification and in the determination of their actual respective distributional range. Obviously the latter problem is partly due to the former. It is with these qualifications that we discussed the data presently available.

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### Zusammenfassung

Das Vorkommen des Afghanfuchses *Vulpes cana* Blanford, 1877 auf dem Afrikanischen Kontinent wird erstmals nachgewiesen. Damit erstreckt sich das bisher bekannte Verbreitungsgebiet der Art von NO Afrika über den Sinai, Israel, den Randbereich der Arabischen Halbinsel und den Iran bis nach W Pakistan und S Tadshikistan. Darin sind allerdings nur wenige, weit voneinander entfernte Einzelnachweise bekannt. Dieses Problem wird ebenso diskutiert wie das der eindeutigen Bestimmung dieser Art und ihrer Abgrenzung gegenüber dem Sandfuchs *V. rueppelli* (Schinz, 1825).

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